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Roman cooking vessels (ollae): a preliminary study of the material from the Pontine region, Central Italy

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ABSTRACT

This paper presents the petrographic analysis of cooking vessels (ollae) from the Pontine region, Central Italy, dated between the 4th and the 1st centuries BC. Cooking vessels of three surveys in different parts of the Pontine Plain and around Norba, in the Lepine foothills, are considered. The considered time-span covers the period in which the Pontine region became integrated in the Roman state until the end of the Republic, and cooking vessels have much to tell us about the region's integration in production and distribution systems, and whether changes occurred therein.

The petrographic study shows that the cooking pots were produced and distributed at regional and supra-regional scales. The production and distribution systems that are tentatively inferred show aspects of continuity and change during the time-span considered. Roman cooking vessels that circulated in the Pontine region between the 4th and the 3rd centuries BC had a supra-regional and regional provenance. During the 2nd and the 1st centuries BC, the region continued to have access to these products, as well as to other ones that were produced within and outside the region. Furthermore, the distribution of supra-regional products increased, whereas the importance of existing regional centres decreased in favour of others.

KEYWORDS

Roman cooking vessels;
Petrography; Pontine region

1. Introduction

Studies that use ceramic evidence to investigate the Roman economy have traditionally focused on materials that were traded internationally, such as amphorae and fine ware, highlighting the interconnectivity of the Roman world. Only recently, more mundane products, such as cooking vessels, have received due attention. Cooking wares are the most commonly encountered group of ceramics in archaeological deposits related to residential sites, given their generally short life-span due to their daily use and frequent handling (Peña, 2007: 57). Moreover, their generally coarse nature makes them suitable for petrographic analysis, providing important indications on how and where these vessels were produced. As a consequence, cooking wares are very suitable to study dominant exchange networks that individual sites and larger regions participated in, and provide vital data for understanding the wider economic phenomena that underlie the manufacture and distribution of these vessels (Spataro & Villing, 2015). Recent research on cooking vessels, dated to between the Late Republican and Imperial periods, highlights their potential in understanding key aspects of ancient economic relations, trade and craft specialisation – North African

cookwares (Leitch, 2011), Pantellerian ware (Santoro Bianchi, 2002), and Pompeian Red Ware (Peña, 1990; Peacock, 1977), to name a few. However, relatively little research to date has been undertaken on Mid- and Late Republican cooking vessels from Central Italy: some studies, using petrographic or chemical analyses, have been carried out on cooking vessels from a number of sites in and around Rome (Bertoldi, 2011; Olcese, 2006; Thierrin-Michael, 2003; Schuring, 1987; Schuring, 1986), and Ostia (Capelli, 2016), whereas other work focused on aspects of production and distribution, demonstrating that such vessels could be distributed as far as Northern Italy, some 600 km away (Peña, 1992; Olcese, 1990).

This article aims to add to the growing corpus of petrographic studies on Roman cooking vessels. It presents the results of a pilot study of two types of cooking jars, dated between the early 4th and the 3rd centuries, and the 2nd and the 1st centuries BC respectively. One is considered to be the typological successor of the other (Olcese, 2003, olla types 2 and 3a). As the analysed fragments were selected from consumption sites only, they are not suited to distil direct relationships between production and consumption. However, understanding the range of fabrics present among the

studied material allows to provide information on the complexity of the organization of production, and helps to assess whether production was confined to a single site or to multiple sites in a larger area. The relevant fragments derive from sites in the Lepine foothills, south of ancient Norba, and from different parts of the Pontine Plain in Southern Lazio, Central Italy. They were collected during three field surveys of the Pontine Region Project (PRP), a long-term research initiative of the Groningen Institute of Archaeology (GIA, University of Groningen, the Netherlands), which is currently carried out in close collaboration with the universities of Melbourne and Cologne. The present study builds upon earlier work by the PRP, which focused on 6th and 5th centuries BC pottery from the Latin town of Satricum (Attema, et al., 2001/2002).

This paper has three aims: first, to characterise the range of ceramic fabrics present among the studied samples, using thin section petrography. Second, to identify their provenance (or broad area of production) on the basis of the fabric descriptions. And third, to gain insight in the production technology and distribution of Roman cooking vessels in the Pontine region, and whether these systems changed during the time-span covered.

Section 2 describes the context of the sample materials and the method used, section 3 presents the different fabrics identified in this study and their possible origin, based on the comparison with published ceramic fabrics and geological samples. Section 4 puts the results in a wider perspective: it focuses on the technology of the Roman cooking vessels, highlighting the presence of persistent technological traditions in the Pontine region, and it discusses the preliminary results on the production and distribution patterns of the cooking ware samples that have been analysed in this study.

2. Archaeological Samples and Method

Our petrographic study focuses on Roman cooking wares that were selected from three surveys in the Pontine region. The selected fragments incorporate two types of jars, usually referred to as olla type 2 and olla type 3a (Olcese, 2003). Both types of vessels are common throughout Western Central Italy, and form part of the highly standardized ceramic repertoire characteristic of Mid- and Late Republican sites in the Pontine region (see Tol, 2012, chapter 5, site 15106 for such a typical Republican context). Common

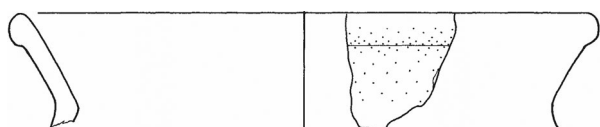


Figure 1. Olla type 2 vessel.

morphological features are an ovoid body and a short neck with marked almond-shaped rim. The most relevant difference between the two types of vessels is in the typology of rims.

Olla type 2 cooking vessels are characterised by a high collared rim with a short convex shaped thickening just below the lip and their diameter varies between 14 and 20 cm (Figure 1). Although the type is known to occur in Southern Etruria and Rome from the 6th century BC onwards, it does not become common in the Pontine region before the beginning of the 4th century BC (Tol, 2012; de Haas, 2011; Bouma, 1996).

In the late 3rd or early 2nd century BC, olla type 3a vessels succeed olla type 2 vessels. They are characterised by an equally high rim, but have a much more pronounced almond shaped thickening below the lip. Their diameter varies generally between 18 and 24 cm (Figure 2) (Bertoldi 2011, 90-91, 95-97; Olcese 2003, type 3a, tav. VIII). Although all fragments from the Pontine region are fairly standardised in shape, a regional variant with a more flattened rim occurs as well (Tol & Borgers, 2016).

Our samples include 46 rim fragments; 16 of olla type 2 vessels, and 30 of olla type 3a vessels (Table 1). The relevant fragments derive from sites and off-site contexts south of the ancient town of Norba on the edge of the Lepine Mountains (de Haas, 2011), around the modern town of Pontinia (de Haas, 2011), and in the surroundings of Forum Appii and Ad Medias, two road stations in the Pontine Plain (Tol, et al., 2014; fig. 3; table 1).

All ceramic rim fragments were prepared as standard 30 µm sections. They were analysed with a polarising light microscope, and grouped in petrographic fabrics according to the nature of their inclusions, clay matrix and voids (Quinn, 2013: 73-79). Compositional, textural and shape criteria were used to detect the presence of specific practices, such as clay mixing and the addition of temper (Quinn, 2013: 156-171).

The fabrics of 4th to 1st centuries BC cooking vessels identified in this study were compared with published fabrics of cooking vessels from various sites in and around Rome (Bertoldi, 2011; Thierrin-Michael, 2003), and Ostia (Capelli, 2016), as well as with the GIA's archive of 6th and 5th centuries BC cooking vessels from the site of Satricum (Attema, et al., 2001/2), with the aim to offer a better consideration of similarities or

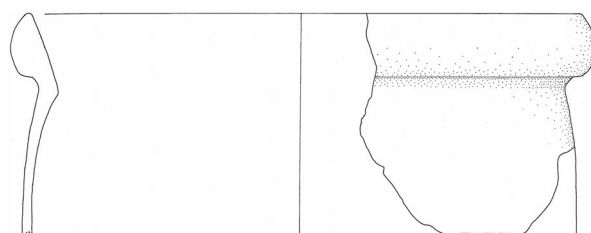


Figure 2. Olla type 3a vessel.

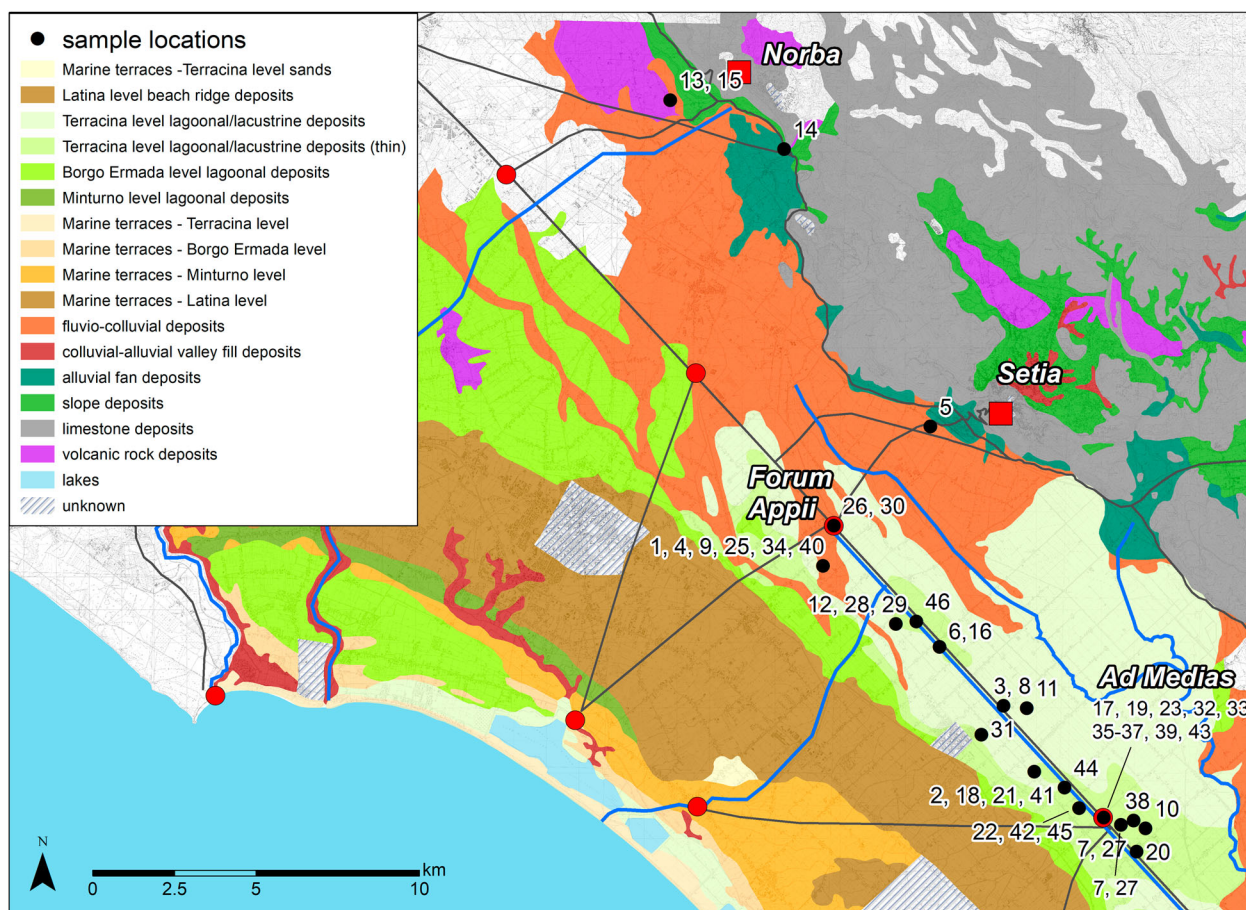


Figure 3. Map of the Pontine region, Central Italy, with the location of the three surveys and sites from which the Roman cooking vessels were selected.

differences in production and distribution systems between the Late Archaic and Republican periods. Furthermore, the petrographic fabrics identified in this study were compared with reference collections of geological samples that are available at the GIA's Laboratory for Conservation and Material Studies (www.lcm.rug.nl), and in the literature (Peña, 1992; Sevink, et al., 1984), in order to shed light on their provenance.

3. Results

3.1 Range of ceramic fabric groups present among the cooking vessels

Four main fabric groups were identified among the Roman cooking vessels (Table 2). A summary of the fabric groups is given below, and the detailed descriptions of the features of these groups can be found online (<http://minorcenters.gia-mediterranean.nl/petrographic-data/>).

3.1.1 Fabric Group 1: Coarse Sanidine and Augite Fabric (Figure 4.A)

This large heterogeneous fabric is defined by the presence of generally moderately to poorly-sorted inclusions of sanidine (3.2 mm), augite and iron (> 2 mm), set in a red base-clay with fine sanidine, biotite and iron inclusions (< 0.2 mm). The coarse sanidine inclusions

are sub-angular to sub-rounded, and show cracks. The principal mineral inclusions include sanidine and augite, plus occasionally plagioclase and partially bent biotite, and very rarely weathered igneous rock, composed of fine plagioclase inclusions in an opaque matrix, as well as zeolite. The coarse fraction, consisting predominantly of volcanic mineral inclusions, is about 15%, and includes some compositional variation, with a number of samples that are characterised by a variable proportion of augite and/or biotite inclusions.

The samples in this fabric were made from a volcanic clay. Volcanic temper, consisting of a mixture of volcanic mineral inclusions, has been added. All the vessels were wheel thrown, as suggested by the alignment of the coarse inclusions and voids, and fired at a high temperature. Some samples were well fired in an oxidising atmosphere, but the atmospheric conditions appear to have varied within most sherds, and several samples were incompletely oxidised. Both olla type 2 and olla type 3a cooking jars occur in Fabric 1. This fabric is closely related to Fabric 4 in this study.

3.1.2 Fabric Group 2: Coarse Augite Fabric Group (Figure 4.B)

This fabric is characterised by well-sorted, sand-sized augite and sanidine inclusions (< 2 mm), set in a red

Table 1. 46 samples of Roman cooking vessels from rural sites and off-site contexts in the Pontine region.

Sample	Vessel shape	Context	Survey	Petro. Fabric
1	Olla type 2	Site 14053	Forum Appii	1
2	Olla type 2	Site 14003	Ad Medias	1
3	Olla type 2	Site 14016	Ad Medias	1
4	Olla type 2	Site 14053	Forum Appii	1
5	Olla type 2	Site 14062	Forum Appii	1
6	Olla type 2	Site 13433	Pontinia	1
7	Olla type 2	Site 14026	Ad Medias	2
8	Olla type 2	Site 14017	Ad Medias	2
9	Olla type 2	Site 14053	Forum Appii	2
10	Olla type 2	Site 14041	Ad Medias	2
11	Olla type 2	Site 14019	Ad Medias	2
12	Olla type 2	Site 12309	Pontinia	2
13	Olla type 2	Site 12408	Norba	2
14	Olla type 2	Site 10952	Norba	2
15	Olla type 2	Site 12408	Norba	2
16	Olla type 2	Site 13433	Pontinia	2
17	Olla type 3a	Unit ID 101233/01/01	Ad Medias	1
18	Olla type 3a	Site 14003	Ad Medias	1
19	Olla type 3a	Ad Medias	Ad Medias	1
20	Olla type 3a	Site 14044	Ad Medias	1
21	Olla type 3a	Site 14003	Ad Medias	1
22	Olla type 3a	Unit ID 101724/01/03	Ad Medias	1
23	Olla type 3a	Ad Medias	Ad Medias	1
24	Olla type 3a	Site 14033	Ad Medias	1
25	Olla type 3a	Site 14053	Forum Appii	1
26	Olla type 3a	Forum Appii	Forum Appii	1
27	Olla type 3a	Unit ID 100140/2/8	Ad Medias	1
28	Olla type 3a	Site 12307	Pontinia	1
29	Olla type 3a	Unit ID 1433/01/01	Pontinia	1
30	Olla type 3a	Forum Appii	Forum Appii	2
31	Olla type 3a	Site 14006	Ad Medias	2
32	Olla type 3a	Unit ID 101590	Ad Medias	3
33	Olla type 3a	Unit ID 101590	Ad Medias	3
34	Olla type 3a	Site 14053	Forum Appii	3
35	Olla type 3a	Ad Medias	Ad Medias	3
36	Olla type 3a	Ad Medias	Ad Medias	3
37	Olla type 3a	Ad Medias	Ad Medias	3
38	Olla type 3a	Site 14040	Ad Medias	3
39	Olla type 3a	Ad Medias	Ad Medias	3
40	Olla type 3a	Site 14053	Forum Appii	3
41	Olla type 3a	Site 14003	Ad Medias	3
42	Olla type 3a	Site 14034	Ad Medias	4
43	Olla type 3a	Ad Medias	Ad Medias	4
44	Olla type 3a	Site 14038	Ad Medias	4
45	Olla type 3a	Site 14034	Ad Medias	4
46	Olla type 3a	Site 12305	Pontinia	4

base-clay with fine sanidine and biotite (0.2 mm). The principal mineral inclusions include augite and sanidine, plus less common biotite and chert. Occasionally, zeolite can be identified as euhedral microphenocrysts of leucite in an opaque to brownish groundmass (< 3 mm), whereas leucite and olivine occur rarely (< 3 mm). The coarse fraction is about 10%. The rounded nature of the augite and sanidine inclusions suggests that they were the product of weathering. The presence of these volcanic mineral inclusions, as well as the composition of rock fragments, suggests that the clay used to produce these ceramics was a volcanic tuff.

Table 2. Four different fabrics were identified among the 46 Roman cooking vessels.

Vessel shape	Samples	Petrographic Fabric	Nr. of Samples
Olla type 2	1, 2, 3, 4, 5, 6	Coarse Sanidine and Augite Fabric	6
Olla type 3a	17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29	Coarse Sanidine and Augite Fabric	13
Olla type 2	7, 8, 9, 10, 11, 12, 13, 14, 15, 16	Coarse Augite Fabric	10
Olla type 3a	30, 31	Coarse Augite Fabric	2
Olla type 3a	32, 33, 34, 35, 36, 37, 38, 39, 40, 41	Coarse Calcite Fabric	10
Olla type 3a	42, 43, 44, 45, 46	Coarse Sanidine Fabric	5

The samples in Fabric 2 were made from a tuff deposit. Coarse inclusions and voids show a preferred alignment, suggesting that the vessels were wheel thrown. Some vessels were well fired in an oxidising atmosphere, while most show evidence for different firing horizons. All but two vessels were fired at a high temperature, and this fabric comprises both olla type 2 and olla type 3a cooking jars.

3.1.3 Fabric Group 3: Coarse Calcite Fabric Group (Figure 4.C)

This fabric is defined by the presence of moderately to well-sorted, angular to sub-angular inclusions of calcite (< 3.5 mm) and sanidine (< 2-1 mm), set in a red base-clay with fine sanidine and iron (< 0.2 mm). The coarse fraction is about 18%. The fresh nature of the calcite inclusions suggests that they were added to the clay matrix, rather than being the product of weathering, and they appear to derive from limestone rock. The principal minerals include sanidine, plus less common iron. Given that the sanidine inclusions are well-sorted, and sub-angular to sub-rounded, the raw materials used to produce these ceramics appear to have come from a volcanic clay. The presence of micrite in voids, and the absence of calcareous textural features in the clay matrix, suggests that these fine-grained minerals are secondary, rather than the result of the mixing of two clay sources.

The samples in this fabric were made from a volcanic clay deposit. It appears that crushed calcite has been used as temper, and added in a moderately sorted condition to this base clay. Inclusions and voids are randomly orientated in the core of the section, and aligned near the rim, suggesting that the vessels were handmade and wheel finished. Most, if not all, samples were fired at a high temperature, and calcite inclusions have been fired out, leaving characteristic voids behind. There also appears to be considerable variety in firing atmosphere, given that some samples are oxidised, others are reduced, but the majority of the samples are characterised by different firing horizons. This evidence suggests that the firing process was considerably

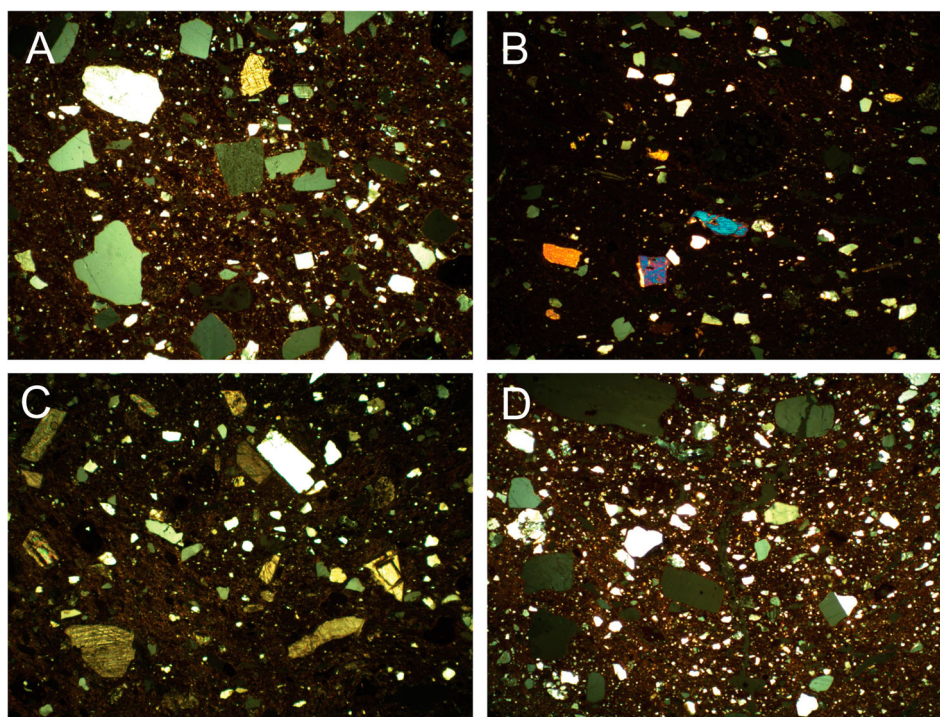


Figure 4. Micrographs of ceramic thin sections in XP: Coarse Sanidine and Augite Fabric (A), Coarse Augite Fabric (B), Coarse Calcite Fabric (C), Coarse Sanidine Fabric (D). Width of individual images = 5.8 mm.

uncontrolled. All the samples of Fabric 3 belong to olla type 3a vessels.

3.1.4 Fabric Group 4: Coarse Sanidine Fabric Group (Figure 4.D)

This coarse to fine-grained fabric is characterised by the presence of generally moderately well-sorted, sub-angular to sub-rounded inclusions of sanidine (generally around 2 mm, rarely < 3 mm), in a red base-clay with fine sanidine, biotite and iron (< 0.2 mm). The coarse inclusions of sanidine show cracks and are predominant, whereas iron and augite occur rarely. The coarse fraction varies between 10% and 15%. Some textural variation has been included in the Coarse Sanidine Fabric, with some samples characterised by a higher proportion of poorly-sorted, coarse sanidine inclusions (< 3 mm), and others with comparatively more fine-grained and well-sorted inclusions of sanidine (< 2 mm). This evidence might be taken to suggest that a different size fraction of temper material was used to manufacture the vessels.

The raw materials used to produce the ceramics in Fabric 4 appear to have come from a volcanic clay. Volcanic temper, in the form of sanidine inclusions, has been added in a moderately sorted condition. All the vessels were wheel thrown, and fired at a high temperature. However, differences can be noted in the firing atmosphere: some vessels were well fired in either an oxidising or a reducing atmosphere, whereas others show evidence for different firing horizons. All the samples in this fabric comprise olla type 3a cooking vessels. This fabric is similar to Fabric 1 (the Coarse

Sanidine and Augite Fabric), but with the difference that the clay matrix in this fabric comprises a larger fine-grained fraction, and coarse augite inclusions occur only rarely.

3.2 Comparison with other ceramic fabrics

Fabric 1 is the largest group in this study. This fabric is closely related to the 'Rome and Tiber Valley Fabric', which is characterised by volcanic temper, dominated by sand-sized inclusions of sanidine, and variable amounts of augite (clinopyroxene), plus less common biotite and plagioclase, and rarely leucite (Bertoldi, 2011: 116; Thierrin-Michael, 2003: 55-59). The 'Rome and Tiber Valley Fabric' has been identified on various sites in and around Rome and Northern Lazio, and was used to produce a wide range of cooking vessels, including different types of ollae (Bertoldi, 2011: 113-121; Thierrin-Michael, 2003: 55-59; Schuring 1987; Schuring 1986). This fabric is likely to comprise several local fabrics from production centres around Rome and further upstream the Tiber River, such as Vasanello (Peña, 1992), given that it includes considerable compositional variation (Thierrin-Michael, 2003: 55-59). Also, Fabric 1 in our study is characterised by a mixture of different volcanic mineral inclusions, and it is likely that it can be subdivided into several smaller groups. However, a larger dataset of ceramic thin sections would have to be examined before this can be accomplished.

Fabric 2 is closely related to the 'Mineralogical Group 5' Fabric, which is defined by the presence

Table 3. Geological samples analysed in this study.

Sample	Site	Type	Description	Before firing	After firing
1	Forum Appii	Clay	Fluvio-colluvial clay	Deep brown	Deep red
2	Forum Appii	Clay	Fluvio-colluvial clay	Deep brown	Deep red
3	North of Forum Appii	Clay	Fluvio-colluvial clay	Deep brown	Deep red
4	North of Forum Appii	Clay	Fluvio-colluvial clay	Deep brown	Deep red
5	Forum Appii	Sand	Clinopyroxene, leucite, olivine	-	-
6	Satricum	Clay	Mid-Pleistocene tuffs	Light-coloured	Pale pink to orange
7	Sezze/Bassiano	Clay	Weathered volcanic tuff	Light-coloured	Orange
8	Sezze/Bassiano	Clay	Weathered volcanic tuff	Light-coloured	Orange
9	Site 11232	Sand	Clinopyroxene	-	-
10	Site 12317	Sand	Sanidine, clinopyroxene, biotite, iron-manganese concretions	-	-

of coarse weathered volcanic rock inclusions, sanidine, plagioclase, clinopyroxene, and rare biotite, leucite and olivine, in a red base-clay (Capelli, 2016: 196–198). The ‘Mineralogical Group 5’ Fabric has been identified in olla type 3a vessels from Ostia (Olcese & Coletti, 2016), for which a provenance from either Southern Lazio or Campania has been proposed (Capelli, 2016: 198).

Fabric 3 in this study does not appear to be related to any published Central Italian ceramic fabric. Yet still, the surviving coarse inclusions indicate that they derive from limestone rocks, which characterise the Lepine Mountains to the southeast of Rome (Figure 5). In this mountainous area, pottery is known to having been produced at the site of Segni during the Mid-Republican period (Olcese, 2011: 149–150, 203–207; Olcese, 2003: 14). Two misfired cooking vessels from the site have been analysed chemically (Olcese, 2003: 160 table 6), one of which is low in calcite (1, 42%), whereas the other is calcareous (14,27%) (Olcese, 2003: 167). However, these samples were not examined in thin section petrography, making it difficult, therefore, to confirm whether Fabric 3 in this study was produced at Segni. Alternatively, Fabric 3 might have been produced in the Pontine region, and there is some evidence to support this hypothesis: in four samples of Fabric 3, it can be seen that coarse calcite inclusions have burnt out (section 3.1.3). Given that temperatures reached during cooking are not sufficient to result in decomposition of mineral inclusions, the calcite must have burnt out during the initial firing process. All four samples derive from the site at Ad Medias (Table 1), suggesting that this site was the place of production (Tol & Borgers, 2016). Pottery is known to having been produced at Ad Medias during the Late Republican period (Tol, et al., 2014). The ceramics include tiles and amphorae, which occur in two petrographic fabrics, respectively the ‘Colluvial Fabric’ and the ‘Clay Mixing Fabric’ (Borgers, et al., *in press*). However, neither fabric is related to Fabric 3 in this study.

Fabric 4 appears to be similar to the well-sorted, fine-grained sanidine-rich fabric that has been identified at the Tempio della Concordia in Rome (Thierrin-Michael, 2003: 56). For the samples from the Tempio della Concordia, a provenance from either the Rome and Tiber Valley region, or Northern

Campania has been proposed (Thierrin-Michael, 2003: 56). One reason why these samples may not have been produced in Northern Campania is that, according to the results of the chemical analysis, they are grouped with the samples of the large ‘Rome and Tiber Valley Fabric’ (Olcese, 2003: 49–50, 87).

3.3 Comparison with raw material samples

In order to identify the possible raw materials used to produce the Roman cooking vessels examined in this study, geological samples and loose sandy deposits, which have been collected by the GIA in the Pontine region, were examined and compared with the identified ceramic fabrics (Table 3) (see Attema, et al., 2001/2: 378; Nijboer, 1998: 121–129 for geological sampling carried out at Satricum; see Borgers, et al., *in press*, for clay prospection carried out in the context of Roman pottery production in the region).

The Pontine region lies on the Tyrrhenian coast, c. 60 km south of Rome. It consists of a plain, which is bounded by the Alban Hills in the north and the Lepine Mountains to the east. From a geological point view, the region can be described as a graben, which is filled with deposits of several marine terraces, and Holocene fluvio-colluvial deposits. In the north-west, these sediments merge with the lower slopes of the Volcano Laziale, whereas limestone rocks border the graben to the north and east (Figure 5) (Sevink et al., 1984).

Relevant deposits for the purpose of this study are a) poorly-sorted Holocene fluvio-colluvial clay deposits, which contain abundant volcanic material (sanidine, clinopyroxene, biotite and leucite), b) Mid-Pleistocene volcanic tuff deposits with abundant volcanic material (leucite, clinopyroxene, olivine, biotite), and their weathered deposits, and c) limestone-based colluvial deposits with carbonate rock fragments and admixture of volcanic material (clinopyroxene, sanidine) (Sevink, et al., 1984). All these sediments are high in kaolinite/kaolinite clay minerals, and fire to a red, or a pale pink to orange colour (Table 3) (Sevink, et al., 1984).

Volcanic tuff deposits, containing a mixture of coarse inclusions of clinopyroxene, biotite, olivine, leucite, and chert, may have been used as a base-clay for Fabric 2 (‘Coarse Augite Fabric’). This fabric comprises

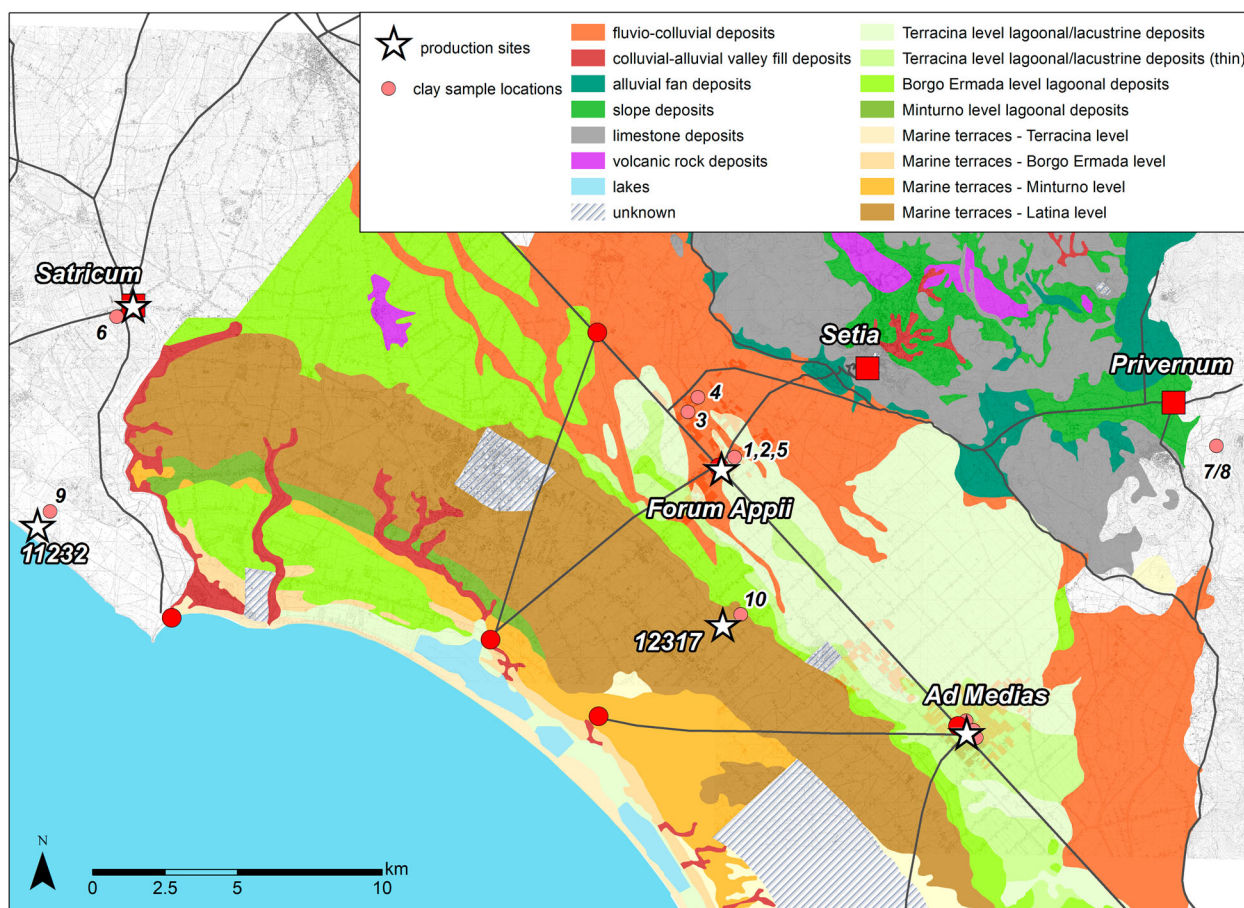


Figure 5. Geological map of the Pontine region (after Sevink, et al., 1984), with indication of Roman pottery production sites and geological samples.

both olla type 2 and olla type 3a vessels, and occurs throughout the Mid- and Late Republican periods in the Pontine region. Geological prospection indicated that volcanic tuffs outcrop near the site at Satricum (Figure 5; Table 3: geological sample 6), where they have been used to manufacture pottery and tiles during the Late Archaic period (Attema et al., 2001/2: 378).

Weathered volcanic clay deposits, rich in fine fraction inclusions of sanidine and biotite, are related to the fine, red base-clay that has been used to produce the vessels in Fabric 1 ('Coarse Sanidine and Augite Fabric'), and Fabric 4 ('Coarse Sanidine Fabric'). Geological prospection indicates that such fine-grained red clay deposits occur around Sezze/Bassiano (Figure 5; Table 3: geological samples 7-8). However, it should be noted that the clay deposits are characterised by the presence of iron-rich clay pellets, which have not been identified in the two ceramic fabrics. In addition, from the evidence seen in thin section, both ceramic fabric groups appear to have been tempered with coarse inclusions of sanidine, and less common augite. Sandy fluvio-colluvial sediments are abundant in ditches in the Pontine plain (Figure 5; Table 3: geological samples 5 and 10), and they appear to have been used as tempering material to manufacture Roman ceramic building material and storage jars in the region

(Borgers, et al., *in press*). However, besides the presence of coarse inclusions of sanidine, these sediments also comprise considerable quantities of clinopyroxene. Indeed, this mineral occurs everywhere in the Pontine Plain and the coastal area (Sevink, et al., 1984) (Figure 5; Table 3: geological sample 9). In addition, clay deposits containing alkaline volcanic sands (sanidine, plagioclase) appear to occur in restricted areas of Northern Lazio and Northern Campania (D'Ambrosio, et al., 2015; Thierrin-Michael, 2003: 56; Peña, 1992: 116 footnote 10; Giannetti & Luhr, 1983). Therefore, it seems unlikely that Fabric 1 and Fabric 4 were produced in the Pontine region.

Limestone-based colluvial deposits may have been used as a base-clay for Fabric 3 ('Coarse Calcite Fabric'), as they typically comprise carbonate rock fragments, iron, as well as volcanic minerals (clinopyroxene, sanidine) (Sevink, et al., 1984; Spaargaren, 1979). These deposits occur on the slopes of the Lepine Mountains (Figure 5). It is difficult to allocate a centre of production for Fabric 3 with certainty, nevertheless two centres of production are potential candidates: the first is Segni, because of its location in the Lepine Mountains. If Fabric 3 was produced here, indeed, then did pottery production at the site continue until the Late Republican period. The second potential

production centre is Ad Medias, which is located in the Pontine Plain. If Fabric 3 is a local fabric from this site, then the raw materials used to produce the cooking vessels should have been transported, given that Ad Medias is situated on marine sediments of the Borgo Ermada complex (Figure 5). One argument that supports this hypothesis is that the raw materials used to produce tiles and amphorae at the site during the Late Republican period were also transported (Borgers, et al., *in press*).

4. Discussion

4.1 Technology of cooking vessels

The petrographic analysis of the Roman cooking vessels that were presented in this study show important similarities and differences at the compositional, technological or typological levels.

All the studied cookware samples were produced with a red base-clay of volcanic origin. The use of red-firing clay for the manufacture of these utilitarian vessels appears to have been a tradition that potters shared and passed on for centuries (Olcese, 2003: 60-61; Thierrin-Michael, 2003: 55-59). Fabric 2 is a case in point. This fabric appears to be closely related to the 'Coarse gritty/leucite-lava and leucite/tuff' Fabric from Satricum (Fabric 12 in Attema, et al., 2001/2: 375, 378; fig. 5). This fabric was identified in waster products from a kiln site, dated to around the late 6th century BC, and used to produce storage jars, bowls, ollae and tiles (Nijboer, 1998: 121-129). Both Fabric 2 in this study and Fabric 12 in the Late Archaic kiln site from Satricum are characterised by the presence of sand-sized inclusions of predominant augite, plus less common biotite, chert, and rare leucite, zeolite and olivine, suggesting that similar raw materials were used to manufacture ollae between the Late Archaic and Roman periods. However, there appear to exist technological differences between the two fabrics. More specifically, the Late Archaic vessels in Fabric 12 are characterised by the presence of poorly-sorted coarse inclusions, and they appear to have been modelled on a turntable (Nijboer, 1998: 121-129). By comparison, the Roman vessels in Fabric 2 are defined by the presence of well-sorted, smaller coarse inclusions, set in a homogeneous clay matrix. This evidence might be taken to suggest that the clay deposit was refined - i.e. coarse inclusions were removed - for the manufacture of Roman cooking vessels. Also, the evidence in thin section suggests that the Roman vessels were wheel thrown. However, it is difficult to support this hypothesis by macroscopic observations, because the sherds tend to be abraded, and comprise the rims of the vessels most of the time.

The samples also differ in terms of the nature and size of the coarse inclusions. More specifically, Fabric 1 and

Fabric 4, comprising the bulk of the samples analysed, are defined by the presence of predominant sanidine inclusions, and less common augite, Fabric 2 by the presence of augite inclusions, whereas Fabric 3 is characterised by coarse calcite. Utilitarian performance is one design premise alongside cultural or social factors relating to specific times or places, and availability. Given that these types of inclusions appear to have been confined to the Tiber Valley region/Northern Campania, Southern Lazio, and the Lepine Mountains respectively, they might be relevant in the light of the latter premise, and taken to reflect the specific natural landscape.

The orientation of the coarse inclusions and voids, as seen in thin section analysis, help interpreting the forming technique of the vessels. Following on from the evidence seen in the ceramic thin sections, it seems that the samples of Fabric 1, Fabric 2, and Fabric 4 were wheel made, whereas those of Fabric 3 appear to have been handmade and wheel finished. Ideally, these observations are combined with macroscopic analysis of the sherds analysed. However, this proved to be difficult, because the sherds that were analysed in this study derive from surveys, and tend to be weathered.

Some samples in Fabric 1, Fabric 2 and Fabric 4 are well fired in oxidising atmosphere, but most samples are characterised by different firing horizons. Historical sources suggest that ollae may have had various functions (Hilgers, 1969: 39-40). However, samples from the Pontine region are typically scorched by fire, suggesting that they were primarily used as cooking pots.

Both Fabric 1 and Fabric 2 comprise olla type 2 and olla type 3a cooking vessels, indicating that the workshops that produced them were active between the 4th and the 1st centuries BC. By contrast, Fabric 3 and Fabric 4 comprise exclusively ollae type 3a of vessels, suggesting that the activity of the workshops that produced them was mainly between the 2nd and the 1st centuries BC.

4.2 Correlation of fabrics and surveys: distribution patterns

A careful examination of the fabrics and their distribution allow us to gain insight in the economic networks wherein the Pontine region was integrated, and changes that occurred therein between the 4th and the 1st centuries BC.

Of the sixteen samples of olla type 2 cooking vessels, dated to the Mid-Republican period, ten belong to Fabric 2. Hence, the majority of the cooking vessels were regional products, which were manufactured in the northwestern area of the Pontine region, possibly at or near Satricum. They circulated widely within the region, given that they were identified on various sites in the Pontine Plain, as well as around Norba (Figure 6; Table 2). The six remaining samples belong

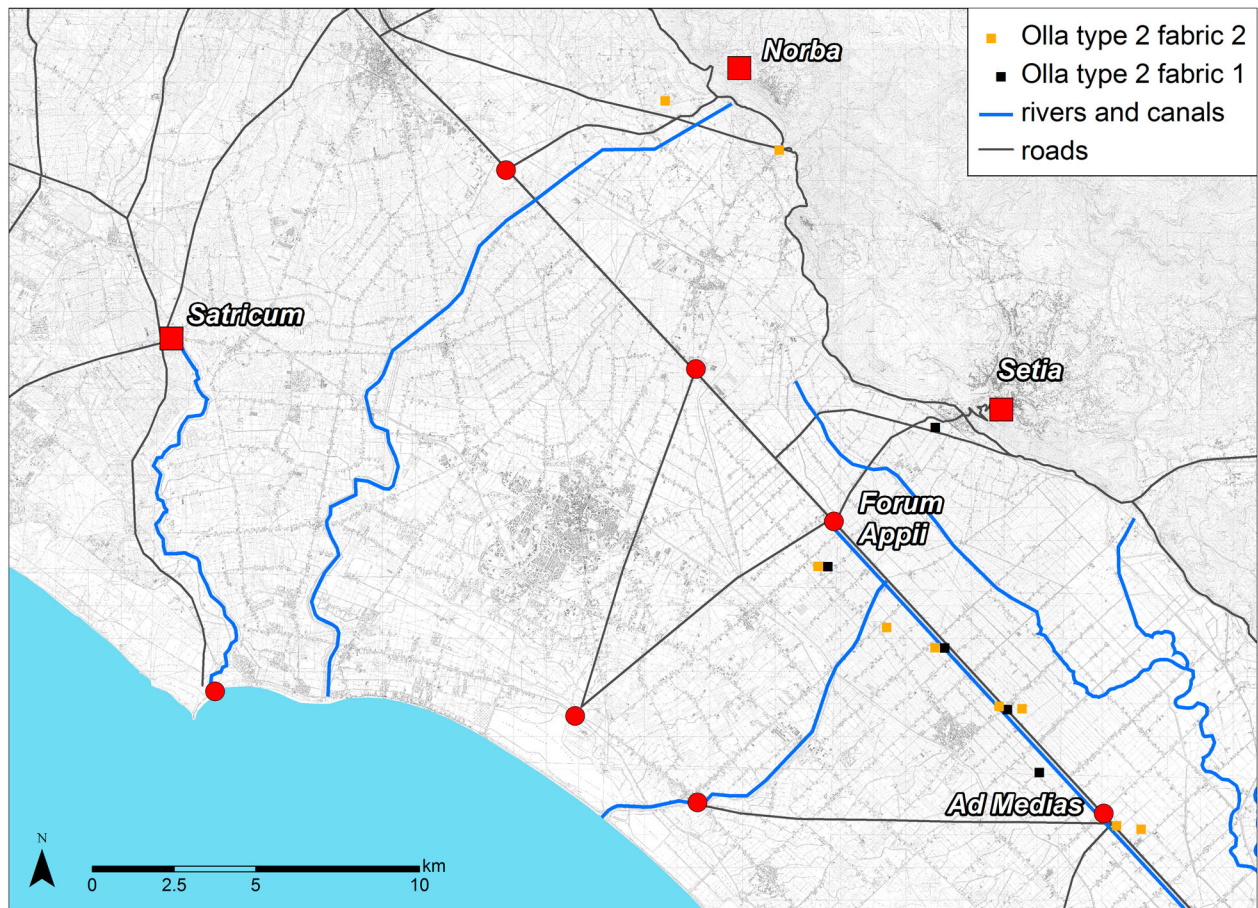


Figure 6. Map showing the distribution of Fabric 1 and Fabric 2 of olla type 2 cookware samples in the Pontine region, dated between the 4th and the 1st centuries BC.

to Fabric 1, which appears to have been produced in the wider Rome and Tiber Valley region. Whilst previous studies have demonstrated that pottery from the Rome and Tiber Valley region were distributed to Northern Italy (Peña, 1992: 117; Olcese, 1990), and Rome (Thierrin-Michael, 2003), the results of our study suggest that the Pontine region was also integrated in the extensive distribution network of this fabric (Figure 6; Table 2).

A more complex picture emerges for the Late Republican period. Of the thirty samples of olla type 3a cooking vessels, thirteen belong to Fabric 1, whereas ten samples belong to Fabric 3, and five to Fabric 4. Fabric 2 is also present, albeit with two samples only (Figure 7; Table 2). Hence, the supra-regional and regional products (Fabric 1 and Fabric 2 respectively) that were distributed in the region during the Mid-Republican period continued to circulate during the Late Republican period, but with the difference that the region had access to other products of supra-regional and regional origin as well (Fabric 4 and Fabric 3 respectively). In addition, when the changing ratio in the number of supra-regional and regional fabrics is considered, it might tentatively be suggested that the trade of supra-regional cooking vessels increased during this period, and a shift occurred in regional production and

distribution systems, with fewer cooking vessels from the northwestern part of the Pontine region, and comparatively more cooking vessels from other parts of the region.

Further research is needed to explore the distribution of Roman cooking pots in the Pontine region in more depth, but the developments described above are consistent with the archaeological background of the Pontine region. Satricum, which is located in the northwestern part of the Pontine region (Figure 5), seems to have been of regional importance with local pottery production during the Archaic and the Mid-Republican periods (Nijboer, 1998). However, other sites and centres of production in the region gained importance in the Late Republican period. For instance, pottery production has been attested on coastal sites, including the Roman villa of Le Grotacce (de Haas, et al., 2008), and on sites that were located on the Via Appia, such as Ad Medias and Forum Appii (Borgers, et al., *in press*; Tol & Borgers, 2016; Tol, et al., 2014; fig. 1). Potters (or middlemen) would have sold their products at or close to the production site, or they might have participated in periodic markets, which would have taken place at most regional centres or sanctuaries. In this context, it might be interesting to note that Forum Appii is thought to have been such a centre where various

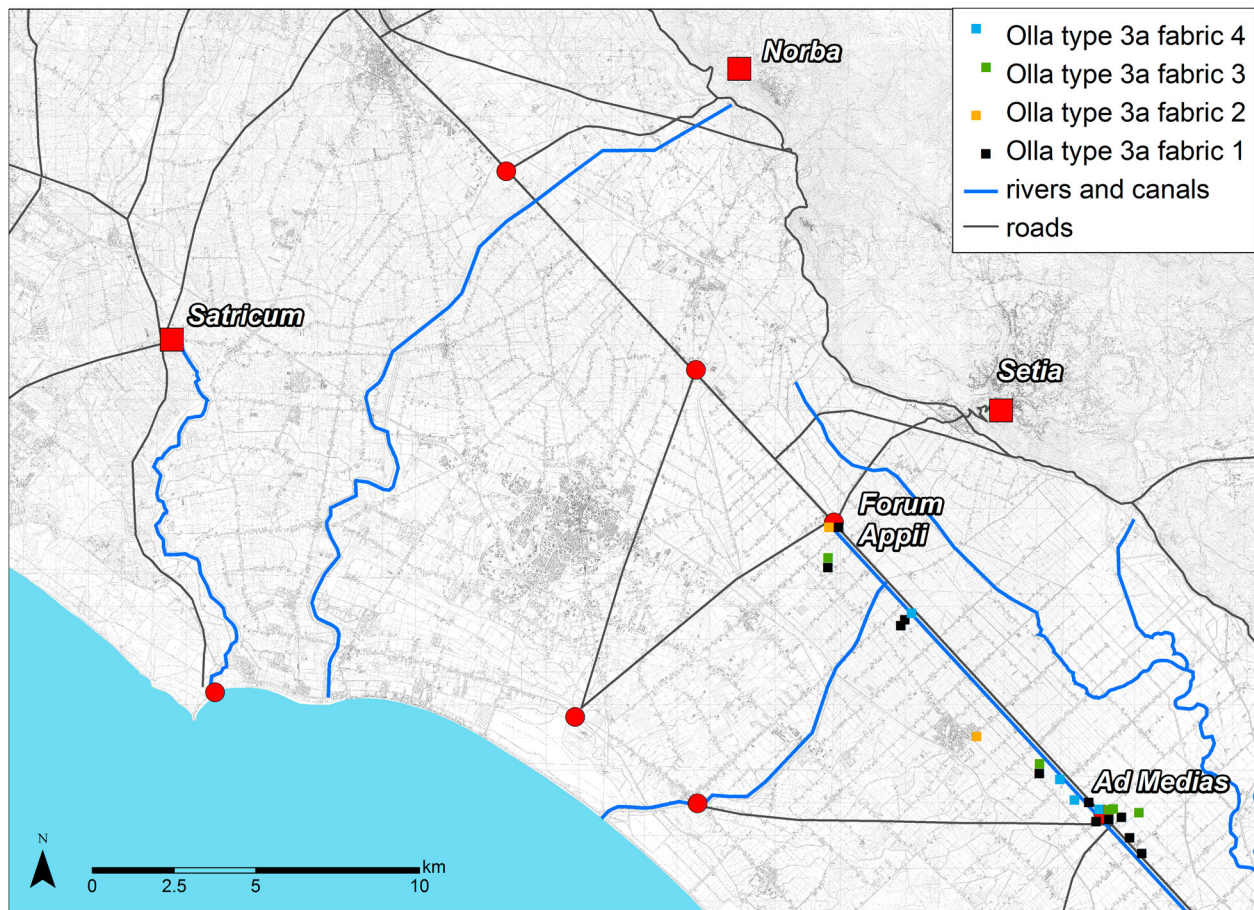


Figure 7. Map showing the distribution of Fabric 1, Fabric 2, Fabric 3 and Fabric 4 of olla type 3a cookware samples in the Pontine region, dated between the 2nd and the 1st centuries BC.

products were distributed (Tol & Borgers, 2016; Tol, et al., 2014).

5. Conclusions

This paper has presented a pilot study of a limited number of two types of Roman cooking vessels from the Pontine region, Central Italy, dated between the 4th and the 1st centuries BC. This study had three main aims. The first aim was to identify and characterise the ceramic fabrics present among the cooking vessels studied, using petrographic analysis. The second aim was to identify their provenance on the basis of published ceramic fabrics and geological samples, whilst the third aim was to reconstruct distribution patterns of this utilitarian ware within the Pontine region, and to identify possible changes therein.

With respect to the first aim, four different fabrics were identified among the Roman cooking vessels. Fabric 1 and Fabric 2 had a supra-regional and regional provenance respectively, and were being produced and used between the 4th and the 1st centuries BC. Similar types of raw materials appear to have been used to manufacture both olla type 2 and olla type 3a vessels, suggesting that potters passed on technological knowledge through time. In addition, Fabric 2 appears to be related to a regional fabric from Satricum, dated

to the Late Archaic period, indicating that technological knowledge dates back at least to that time. The other two fabrics, Fabric 3 and Fabric 4, had a regional and supra-regional provenance respectively, and they circulated in the region during the 2nd and the 1st centuries BC.

As for the second and the third aim, the production and distribution patterns that are tentatively inferred from the Roman cooking vessels in this study show both continuity and change between the 4th and the 1st centuries BC. The workshops that produced cooking pots of Fabric 1 and Fabric 2 seem to have been located in the Tiber Valley region and the northwestern part of the Pontine region respectively. These cooking vessels were distributed to different parts of the Pontine Plain and around Norba, the Lepine foothills, indicating that the region of study was integrated in supra-regional and regional distribution networks during the 4th and the 3rd centuries BC. The Pontine region continued to participate in these networks during the 2nd and the 1st centuries BC, but other supra-regional and regional products also circulated in the region at this time.

More research would be needed in order to better understand the observed developments, and how they relate to broader economic and demographic developments, such as the integration of regional markets in

Rome's Suburbium, and population growth (Morley, 1996). Future research would need to have a more robust quantitative basis, and use an integrated analytical approach. More specifically, a large group of samples would need to be selected from all parts of the Pontine region, in order to gain insight in the various distribution networks wherein the region participated. Also, focused chemical investigation is needed to locate the production centres of Roman cooking vessels. Hence, large-scale scientific research on these utilitarian vessels would illuminate key aspects of their production organisation and trade networks.

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